

# Far-ultraviolet and X-ray dominated regions in galaxy nuclei

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## Abstract.

We developed codes to describe both far-ultraviolet (PDR) and X-ray dominated regions (XDR) with the ultimate aim to explore in some detail the physical environment defined by the central regions in galaxies. We include a large variety of thermal and chemical processes pertaining to irradiated gas. In particular, we include a careful treatment of PAH and H<sub>2</sub> formation, destruction and excitation. For each code, we calculate depth-dependent models at different densities and radiation fields, chosen to mimic conditions in starburst and active galactic nuclei. We make a detailed comparison between PDR and XDR physics for total gas column densities between  $\sim 10^{20}$  and  $\sim 10^{25}$  cm<sup>-2</sup> by calculating cumulative line intensities for a number of selected fine-structure lines such as [CII], [OI], [CI], [SiII], [FeII], and also cumulative column densities and column density ratios for a number of common molecular species such as CO, H<sub>2</sub>, HCO<sup>+</sup>, HCN, and HNC. By comparing the results for PDRs and XDRs we find that, up to  $N_{\text{H}} = 10^{22}$  cm<sup>-2</sup>, column density ratios in XDRs are effectively constant, unlike those in PDRs. In PDRs, for example, the fraction of carbon locked up in carbonmonoxide, i.e. the CO/C ratio, changes over four orders of magnitude starting at the cloud edge and going to a column of  $N_{\text{H}} = 10^{22}$  cm<sup>-2</sup>. At low column H<sub>2</sub> densities, both the carbon monoxide fraction (CO/C ratio) and the carbon monoxide abundance (CO/H<sub>2</sub> ratio) are lower in XDRs than in PDRs. They start to rise only at high column densities  $N_{\text{H}} > 10^{23}$  cm<sup>-2</sup>. At most column densities  $N_{\text{H}} > 3 \times 10^{21}$  cm<sup>-2</sup>, HNC/HCN ratios are lower in XDRs too, but they show a more moderate increase at higher  $N_{\text{H}}$ . Finally, the codes will be applied to a sample of well-known nearby galaxies.

**Keywords.** astrochemistry - galaxies: starburst - galaxies: active

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